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Returns to Vocational Education in Portugal

Sofia Carina dos Santos Oliveira

Student Number 552

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Ana Balcão Reis, Maria do Carmo Seabra and Luís Catela Nunes

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Abstract

In a context of increasing investment in vocational education, it is highly relevant to investigate the impact of this type of education over labor market outcomes. Following a panel of individuals with upper secondary attainment born between January 1974 and December 1990, this study assesses the wage returns to vocational education and general education, between 1993 and 2009. Estimates from a random effects model revealed a wage advantage for workers with vocational education vis-à-vis workers with general education, in the beginning of the career. However, the earnings of the former group grow at a slower rate and are surpassed by the earnings of the latter group at around eight years of experience.

JEL classification: I21, J31

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The author dedicates this work project to her family.

1. Introduction

According to the OECD “[v]ocational education and training (VET) includes education and training programmes designed for, and typically leading to, a particular job or type of job. It normally involves practical training as well as the learning of relevant theory” (OECD, 2009).

Many authors have discussed the advantages of this type of education. Since it equips students with skills that are valued and required by firms, vocational education¹ eases the transition from school to the labor market and potentially increases youth employment. In addition, it helps to avoid school dropouts by serving as an alternative path and perhaps a more motivating one for low-achievement students. (Kulik, 1998; Neuman and Zideman, 1999; Wolter and Ryan, 2011; Cörvers et al., 2011; Hanushek, 2012).

Nevertheless, Krueger and Kumar (2004) stress that education systems strongly based on “skill-specific” knowledge, as opposed to “concept-based” knowledge, may shape a less flexible labor force and lead to a lower country’s growth rate in an era of rapid technological change².

In Portugal, the *Memorandum of Understanding* signed in May 2011 commits the Government to tackle the low qualifications of human capital and “facilitate labor market matching”. Its intention is to boost the “attractiveness and labor market relevance of vocational education and training”. Particularly, one of the targets is to increase the number of students in job-oriented tracks in upper secondary from about 40% in 2012 to 50% in a near future³.

In this context, it is highly relevant to investigate the impact of vocational education over labor market outcomes in the last decades. Hence, this study assesses how students’ investments in differentiated types of education have been paying off in the labor market, from an earnings

¹ In this report, the terms “vocational education” and “job-oriented tracks” are used interchangeably, as opposed to “general education” or “academic track” (see table A.1 in the appendix for the English-Portuguese translations of the terms used in this report).

² According to the authors, this explains why the US (essentially based on general education) grew more than Europe (strongly focused on vocational education) in the eighties and nineties.

³ This information was stated in a speech by the Minister of Education in August 21st 2012.

perspective. Particularly, I address the following questions. First, is there a wage premium to vocational education vis-à-vis general education when entering the labor market? And second, in the presence of such wage advantage, does it dissipates over the worker's lifecycle? Answering both questions will enable the derivation of wage-experience patterns for two groups of workers, one with vocational and the other with general education.

This report is structured as follows. Section 2 links this study to the human capital theory and surveys the relevant literature. Section 3 provides a review of the Portuguese education system, from 1960 to 2004, detailing the evolution of job-oriented tracks. The dataset is presented in section 4, as well as a brief analysis of the data. Section 5 explains the econometric procedure and the relevant findings whilst section 6 derives the policy implications, suggests avenues for further research and concludes the report.

2. Literature Review

Literature on individuals' returns to education focuses on two main lines of investigation: employment and earnings. The earnings approach is nevertheless the most classic one due to the earnings function popularized by Mincer (1974). Moreover, it relates to the seminal work by Becker (1964) where the author develops the human capital theory, firstly introduced by Schultz (1961). This theory establishes schooling and training as investments through which individuals acquire the necessary skills to become more productive in the labor market (Schultz, 1961; Becker, 1964).

According to the job-matching theory, proposed by Jovanovic (1979), the match between the employer's required skills and the employee's current abilities is reflected on worker's productivity and, consequently, on earnings. Particularly, initial earnings mirror the initial

alignment. Then, the quality of the match rises due to on-the-job training⁴ and continuous long-life learning. Therefore, wages increase over time, even though at a decreasing rate (Becker, 1964).

Given the relation between education and the labor market, it is reasonable to expect different types of education to yield different returns. As noted by Weber and Falter (2011), “workers with a different educational background possess a different kind of human capital, which leads to a different pattern of wage growth”. Additionally, job-oriented streams may serve as ability signals in a labor market characterized by asymmetric information, thus representing a wage gain for vocationally educated workers at the beginning of their career (Wolter and Ryan, 2011).

In this literature, a common concern across all studies regards self-selection. Concerning ability, socioeconomic background and aspirations, students who chose job-oriented tracks are likely to differ from those who followed general education (Kulik, 1998; Meer, 2007; Cörvers et al., 2011). Accordingly, Cörvers et al. (2011) stress that “the unobserved heterogeneity may play a role for both the decision to follow a vocational or general educational track and the subsequent earnings profile”. Consequently, in the absence of natural experiments⁵, the potential bias posed by unobserved heterogeneity requires econometric controls⁶ (Wolter and Ryan, 2011).

Another common feature to all studies on the returns to different types of education is the inclusion of firms’ characteristics in order to control for selection into some categories of jobs and firms; for instance, the working field, occupation, firms’ location, bargaining agreement and firms’ size (Neuman and Ziderman, 1999; Pereira and Martins, 2001). Wolter and Ryan (2011) explain

⁴ Wolter and Ryan (2011) provide an extensive revision on firms’ incentive to finance training to their workers.

⁵ In Romania, Malamud and Pop-Eleches (2010) studied a natural experiment of an educational reform in 1973. Using a regression discontinuity model the authors found that having augmented the general component of vocational courses “did not cause an increase in labor market participation or earnings”. In the Netherlands, Oosterbeek and Webbink (2007) also investigated a natural experiment, employing a difference-in-difference approach. After a reform in 1975 all vocational courses became of four years length but the authors estimated no effect of an extra year over wages of students subject to the reform.

⁶ Bishop and Mane (2004) offer a comprehensive list of such controls; namely, the number of years failed, a dummy for having dropped out of school, a dummy for having attended remedial courses, test scores, ethnicity, living area, parents’ schooling and family size.

that “apprenticeship might be superior to other forms of learning for particular skills and occupations, but inferior for others”, so models must account for “occupation-specific factors”.

A cross-country analysis reveals that the existence of differentiated returns to different types of education is not a global and consensual phenomenon. In Austria, Fersterer, Pischke and Winter-Ebmer (2008) showed that workers coming from apprenticeship courses can earn up to 12% more than generally educated workers. Whilst in Israel, Neuman and Ziderman (1999) estimated wage returns of about 8% higher for workers with vocational education but only if the working field is related to the vocational course pursued.

Hanushek, Woessman and Zhang (2011) studied a cross-section of 18 countries. Estimates of a Mincer earnings function revealed that vocationally educated workers have an initial wage advantage (wages are 15.5% higher) but generally educated ones catch up as they become older and end up earning more⁷. Cörvers et al. (2011) investigated this topic in the UK, Germany and Netherlands. The authors estimated a mixed-effects linear regression model and found higher initial earnings for vocational education in both Germany and UK (of about 10% and 5%, respectively). However, wages for generally educated individuals grow faster and surpass those of vocationally educated ones at six years of labor market experience. The authors argue that “general education focuses relatively more on general knowledge and problem solving skills, which could lead to higher learning abilities throughout working life”. For the Netherlands, coefficients on initial and subsequent earnings are both statistically insignificant.

Because Hanushek, Woessman and Zhang (2011) and Cörvers et al. (2011) are interested in the wage-age and wage-experience patterns, respectively, these are the main references for my work. Cörvers et al. (2011) is of particular importance given the panel nature of the dataset used.

⁷ Using a sample of countries that in the dataset had at least 40% of workers with vocational education: Belgium, Check Republic, Denmark, Finland, Germany, Hungary, the Netherlands, Norway, Poland, Switzerland, and Slovenia.

Previous research for the Portuguese labor market is, to my knowledge, very scarce. Only Pereira and Martins (2001) estimated the returns to different education levels and tracks in a Mincer earnings function, using the dataset *Quadros de Pessoal* over the period 1982-1995. The authors concluded that over the time period observed “a lower secondary technical degree pays always more than its academic counterpart”. Regarding upper secondary, data on differentiated tracks was only available for 1994 and 1995, and in both years the obtained coefficients were higher for vocational education.

Another stream of the literature focuses on the returns to training. That is, beyond individuals’ educational attainment, some authors were interested in estimating the impact of participating in different types of vocational training whether in school or during the working life. Saraiva (1999) based his work on the Portuguese *Labor Force Survey* (last quarter of 1996) and Hartog, Pereira and Vieira (2000) used the 1994’s wave of the *European Community Household Panel*. Both papers concluded that vocational training in training centers, vocational schools and apprenticeships do not yield a wage advantage relative to individuals without training. Conversely, there is a positive and high impact of receiving training in a firm – a result corroborated later by Budría and Pereira (2007), who used the Portuguese *Labor Force Survey* from 1998 to 2000.

3. The Portuguese Education System

By 1960, mandatory schooling was four years of primary education and for those wanting to pursue their studies at the secondary level two tracks were available: *ensino liceal* and *ensino técnico*⁸. The former was mainly available in urban areas thus accessible by privileged social classes, and was largely oriented towards higher education. The latter targeted mostly students

⁸ By that time, secondary education (starting after four years of schooling) could last for a maximum of seven years. Pereira and Martins (2001) explain that *ensino liceal* consisted of a first cycle of five years and a second cycle of two years, after which students could apply for universities. *Ensino técnico*, the “labour-market focused stream”, had a first cycle of two years and a second cycle of three or four years.

leaned to learn an occupation and was seen as less prestigious given the lower social status of its students. This partition provided very different educational experiences for its students, hence jeopardizing the principle of equality of opportunities.

In 1973, the *Veiga Simão's Reform* introduced the idea that education should be made accessible for everyone on a meritocratic basis, hence irrespective of one's socioeconomic background. Albeit this reform had not been fully enforced due to the Revolution of April 25th 1974, it promoted a turning point in education policy in the seventies (Stoer, 1982). Accordingly, in 1975 *ensino técnico* was abolished since “[t]his branch of the education system was regarded as incompatible with the revolution goals of equality” (Pereira and Martins, 2001). Around this time *ensino técnico* “was relegated to a residual evening course” (Cerqueira and Martins, 2011).

Nevertheless, two attempts to reintroduce vocational studies in the system were made in the eighties. The first took place in 1980, upon the creation of the 12th grade⁹. Two streams were made available: a general and a vocational one¹⁰. However, the demand for the vocational stream fell short of expectations and was considered a “tremendous failure” (Grácio, 1986). The second was in 1983. A pilot experience shaped by the *Seabra's Reform* added two job-oriented tracks in upper secondary: a three-year *technical vocational course* and a one-year *vocational course*. Nonetheless, these courses were not very successful (Azevedo, 1988). Pereira and Martins (2001) argued that “the academic path was overwhelmingly preferred by prospective upper secondary students”. All in all, despite these two attempts to reintroduce *ensino técnico*, vocational education became nearly absent after 1975.

The system's structure as we know it today was setup in 1986 in *Lei de Bases do Sistema Educativo* (Law 46/86 October 14th). Compulsory schooling increased to nine years of basic

⁹ The 12th grade (final year of upper secondary education) was created in replacement of *ano propedêutico*, the first year of higher education studies.

¹⁰ In Portuguese these were called “via ensino” and “via profissionalizante”, respectively.

education, from 1st to 9th grade¹¹. Upper secondary education, from 10th to 12th grade, stipulated two alternative routes: courses geared towards further studies (labeled *general courses*, and later renamed *scientific and humanistic courses*) and those geared for working life (named *technological courses*).

However, the landmark for vocational education in Portugal occurred later, in January 1989, through the creation of fifty vocational schools, following a commitment to enlarge and diversify the provision of education. These were mainly private schools financially supported by both the Government and the European Union. The courses offered by these schools, called *vocational courses of level III*, certified equivalence to the 12th grade and professional qualification of level III¹². In the literature, the creation of vocational schools is seen as the renaissance of vocational education in Portugal. Moreover, these schools played an essential role in launching job-oriented streams as credible avenues for the completion of upper secondary (Cerqueira and Martins, 2011).

In the beginning of the new century, Government's priority was to tackle a worrying rate of school dropouts and academic underachievement. In particular, it was crucial to assure a soft transition from school to the labor market and to prevent students from leaving the education system early and without the necessary skills to succeed in the labor market. Therefore, the *education and training courses for youth* (or *CEF*) were created. These courses provided professional qualification of level I, II or III and equivalence to the 6th, 9th or 12th grade, respectively.

Meanwhile, the demand for *vocational courses of level III* had been increasing in excess of vocational schools' capacity (ANESPO, 2003). Consequently, these courses were integrated in

¹¹ Divided in three sequential cycles: first cycle, from 1st to 4th grade; second cycle, 5th and 6th grades; and third cycle (or lower secondary education), from 7th to 9th grade.

¹² See table A.2 in the appendix for the correspondence to *Quadro Nacional de Qualificações*, a national framework that relates the learning outcomes in each type of education, in knowledge, skills and attitudes domains, to a qualification level ranging from 1 (lowest) to 8 (highest).

public high-schools in 2004, thus materializing another milestone for this type of education in Portugal. *Technological courses* were progressively reduced in the subsequent years.

Recent data, from the school year 2011/12¹³, reveals that job-oriented tracks account for about 40% of the students enrolled in upper secondary and 10% of those enrolled in lower secondary.

To conclude this review on the Portuguese education system it is relevant to note that its possibilities are not all displayed here. This analysis is neglecting the *apprenticeship courses*¹⁴ and the *education and training for adults* (or *EFA*)¹⁵. Such courses are designed for those who have left the education system and want to return later in life in order to complete a given schooling level (often conciliating studies with a career).

A simplified version of the system is presented in the appendix in figure A.1, while an overview of the Portuguese legislation in education matters can be found in table A.3.

4. Data and Methodology

The dataset used in the empirical study is *Quadros de Pessoal*, a matched employer-employee dataset based on a survey fulfilled every year since 1982 (except 1990 and 2001) by firms with at least one wage earner. The information available in this dataset is therefore immense. On the workers' side I used data on earnings, gender, age, experience, tenure, the type of education (whether vocational or general), the hours worked per week and the hierarchy level within the firm. On the firms' side I used data on the region where the firm is located, the business industry, the ownership (the share of capital stock that is public, private and national or foreign), the number of branches, the number of employees and sales in Euros.

¹³ DGEEC/MEC. *Estatísticas da Educação 2011/12*.

¹⁴ These were created in 1984 under the wing of IIEFP (Institute of Employment and Vocational Training), an institute of the Ministry of Employment.

¹⁵ These were created in 1997 and regulated in 2000.

The selected sample focuses on individuals with upper secondary attainment, since the main reforms of vocational education after the Revolution of 1974 targeted precisely this education level. Moreover, this strategy restrains the sample to individuals with the same schooling level as a way to increase similarity in terms of ability¹⁶.

As explained in section 3, the renascence of vocational education in the post-revolution period occurred in 1989 upon the creation of the vocational schools. Thenceforth, vocational studies expanded rapidly. As a result, the first cohort of students to have obtained a vocational diploma entered the labor market no sooner than the second half of 1992, and no older than 18 years old, have they completed their education in due time. Nevertheless, admitting that students may have failed one year or that recent graduates may dedicate a certain period of time to job-search, I will assume that the first cohort is expected to be observed in the labor market by 1993, and thus with 19 years old. Consequently, applying the same reasoning in every subsequent year, the selected sample is narrowed to individuals born between January 1974 (with 19 years old in 1993) and December 1990 (with 19 years old in 2009). Such panel is therefore an unbalanced one, since individuals born in 1974 can potentially be present in all 17 years of analysis, while those born in proceeding years are observed in a shorter time span.

In summary, I will follow a panel of individuals with upper secondary attainment born between January 1974 and December 1990, between 1993 and 2009. Keeping only the observations with positive earnings, the selected sample accounts for 1,794,272 observations representing 633,549 individuals¹⁷.

Table 1 reports the descriptive statistics. 86.63% of the individuals followed a general track in upper secondary while the remaining ones, 13.37%, followed a job-oriented stream. The share of women is larger in the former group (52.66% and 46.61%, respectively) and the average labor

¹⁶ A similar argument was provided by Cörvers et al. (2011).

¹⁷ In the dataset there are individuals with more than one record per year. Given the impossibility to disentangle potential mistakes from observations corresponding to accumulation of jobs, these observations were withdrawn from the sample.

market experience and average tenure are slightly lower for vocational educated workers. However, almost one third of both groups claim to have entered the labor market before completing the upper secondary level, meaning that they have previous experience. The two groups of workers are also very similar concerning labor supply: the average amount of hours worked per week is between 39 and 40, and about 85% of the workers work full-time¹⁸.

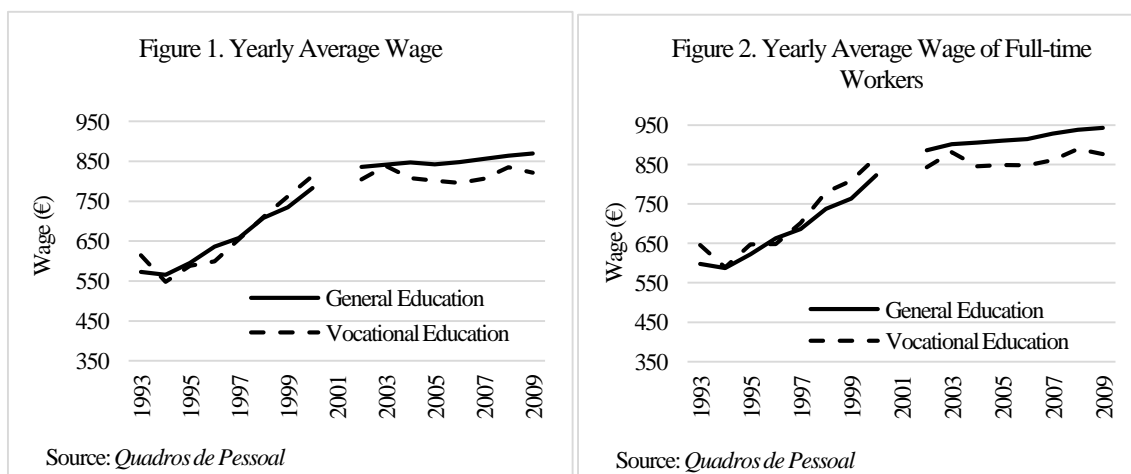
Table 1. Descriptive Statistics

	General Education	Vocational Education		General Education	Vocational Education
No. of individuals	548874	84675	Industry (%)*		
% of the sample	86.63	13.37	Primary	0.83	1.12
Women (%)	52.66	46.61	Extractive industry	0.18	0.23
Experience (mean)	4.06	3.00	Manufacturing	17.34	17.93
Tenure (mean)	4.06	3.00	Utilities	0.41	0.52
Previous experience (%)	31.06	30.61	Construction	7.05	9.86
Hours worked per week (mean)	39.20	39.63	Commerce, restaurants, and hotels	45.37	33.24
Full-time workers (%)	84.63	85.10	Transports and communication	7.15	5.81
Wage (€, mean)	830.95	808.82	Financial institutions, consultancy and real estate	24.73	24.01
Part-time Workers	473.53	445.36	Community services	12.68	12.86
Full-time Workers	891.96	859.55	Total	115.71	105.58
Workers aged ≤20	556.08	587.96	Region (%)*		
Workers aged [21,25]	727.67	752.16	Norte	28.63	29.71
Workers aged [26,30]	933.07	893.48	Algarve	3.96	4.72
Workers aged [31,35]	1077.34	973.83	Centro	16.06	18.53
Women	724.98	696.89	Lisboa	49.87	39.94
Men	952.71	905.66	Alentejo	5.08	4.74
Hierarchy Level (%)*			Açores	1.96	2.24
Senior management	1.84	2.28	Madeira	2.61	2.19
Middle management	3.15	4.02	Foreign	0.01	0.00
Crew chiefs	2.64	1.98	Total	108.18	102.07
Highly qualified professional	9.92	10.39	Present with 18yr old (%)	5.81	5.04
Qualified professionals	49.13	43.01	Present with 19yr old (%)	13.46	12.16
Semi-qualified professionals	24.95	19.23	Present with 20yr old (%)	20.81	18.43
Non-qualified professionals and Apprentices	38.63	28.45	Present with 21yr old (%)	26.91	23.64
Total	140.41	120.64			

* Percentages are computed as the ratio between the number of observations in the panel and the number of individuals.
Source: *Quadros de Pessoal*

¹⁸ I defined full-time workers as workers who work 35 hours or more per week.

Figure 1 provides an overview of the wages¹⁹ of both groups, from 1993 to 2009. At a first glance, with exception for four data points (1993, 1998, 1999 and 2000), vocationally educated workers earn persistently less than their counterparts. However, when concentrating on full-time workers only, figure 2 reveals that until 2000 vocationally educated workers earned more than generally educated ones, while from 2002 onwards the reverse happened. This behavior is related to an important feature of the sample: the panel is unbalanced in such a way that the average age increases with time. The average age in the first decade under analysis is lower than in the second decade, and, if the answers to the research questions of this empirical work are positive, the difference in the earnings of the two groups should favor vocationally educated workers for recent entrants (thus younger cohorts) and favor the other group for older and more experienced individuals. Indeed, in table 1, the average wage broken down by age cohorts supports the argument that the wage-differential in the two decades is being driven by the age composition of the sample in the two moments.



To investigate further differences between the two groups of workers, table 1 reports the share of individuals by hierarchy levels of the firm, business industry and region. Statistics reveal that the percentage of vocationally educated workers in positions of senior and middle management is

¹⁹ “Wage” refers to the total real wage. That is, I summed the fixed pay with regular and occasional payments to obtain the total nominal wage, and then I converted it into real values using the CPI deflator (basis 2009).

slightly higher than that of generally educated ones (6.3% and 5%, respectively) and that the share of individuals that are (or were at some point in time) non-qualified professionals and apprentices is much larger among workers with general education than within the other group (38.63% and 28.45%, respectively). However, the “total” row does not sum to 100% since workers can climb the hierarchical structure and report different levels in different years. This “total” is larger for the group of workers with general education indicating that there were more promotions in this group.

Regarding the business industry, both groups of workers work predominantly in the same sectors (commerce, restaurants and hotels are on top in the employment structure followed by financial institutions, consultancy and real estate and then manufacturing). The main differences are verified in construction, which employs about 10% of the individuals with vocational education and 7% of the individuals with general studies, and in commerce, restaurants and hotels, where are employed 45% of the generally educated workers against 33% of the vocationally educated ones. Once more, the “total” figure is larger for workers with general education suggesting a higher flexibility in changing between sectors of activity.

5. Empirical Model and Results

The benchmark model to analyze the liaison between the type of education and earnings is the following:

$$lwage_{it} = \beta_0 + \beta_1 female_i + \beta_2 age_{it} + \beta_3 age_{it}^2 + \beta_4 exp_{it} + \beta_5 exp_{it}^2 + \beta_6 voc_i + \beta_7 voc_i * exp_{it} + \beta_8 voc_i * exp_{it}^2 + \beta_9 previousexp_i + \beta_{10} voc_i * previousexp_i + \beta_{11} tenure_{it} + \beta_{12} tenure_{it}^2 + \beta_{13} T_t + \varepsilon_{it} \quad (1)$$

The dependent variable is the logarithm of wage, *lwage*, and the independent variables are as follows: *female* is a binary variable equal to 1 if the individual is a female and 0 if male, *age* is the age of the individual and *age*² corresponds to its square, *exp* accounts for the number of years the individual is observed in *Quadros de Pessoal* until period *t* and *exp*² is its square, *voc*

is a binary variable equal to 1 if the individual followed a job-oriented track in upper secondary and 0 if it followed a general stream, *previousexp* is a dummy variable equal to 1 if the individual was registered in *Quadros de Pessoal* before reporting upper secondary attainment (that is, if he has working experience prior to completing upper secondary education), *tenure* is the number of years an employee has been working in that firm and *tenure*² corresponds to its square. T_t refers to a vector of time dummies in order to control for macroeconomic events²⁰.

The wage-experiences patterns are captured by the coefficients of *voc*, *exp*, *exp*², and the interactions *voc* * *exp* and *voc* * *exp*². The coefficient of *voc* denotes the initial (when experience is equal to zero) wage advantage (if it is positive) of workers with vocational education relative to those with general education. The coefficients of *exp* and *exp*² show how the wage evolves with labor market experience for the group of generally educated workers, specifically the slope and curvature of their wage pattern. Whilst *voc* * *exp* and *voc* * *exp*² represent existent differences in that pattern (slope and concavity, respectively) for the vocationally educated ones.

Firstly, I estimated model (1) by OLS. Results are shown in column (A) of table 2. The coefficient of *voc* is positive thus suggesting that there is indeed a wage gain at the beginning of the career for workers with vocational education. However, the negative coefficients of *voc* * *exp* and *voc* * *exp*² reveal that wages for this group grow slower than for workers with general education and that the former group will eventually be surpassed by the latter.

Nevertheless, because the pooled OLS model does not account for the fact that the same individual is observed several times in the sample, I then moved towards a panel method. Thus, I estimated model (2) (where μ_i denotes the individual-specific effects) by random effects (RE) and employed the Breusch and Pagan Lagrangian Multiplier Test to test for the presence of random

²⁰ I tested for the inclusion of time fixed-effects. Table A.4 in the appendix shows that the null hypothesis that the coefficients of time dummies are jointly equal to zero is rejected at all significance levels.

effects²¹. The test rejected the null hypothesis that the variance of the individual-specific effects is zero, and hence OLS is not efficient.

$$lwage_{it} = \beta_0 + \beta_1 female_i + \beta_2 age_{it} + \beta_3 age_{it}^2 + \beta_4 exp_{it} + \beta_5 exp_{it}^2 + \beta_6 voc_i + \beta_7 voc_i * exp_{it} + \beta_8 voc_i * exp_{it}^2 + \beta_9 previousexp_i + \beta_{10} voc_i * previousexp_i + \beta_{11} tenure_{it} + \beta_{12} tenure_{it}^2 + \beta_{13} T_t + \mu_i + \varepsilon_{it} \quad (2)$$

Afterwards, I estimated model (2) by fixed effects (FE) and run an Hausman Test to test for the difference between FE and RE estimates²². The Hausman Test failed to reject the null hypothesis that the difference in coefficients is not systematic, and therefore, both estimators are consistent while the RE one is efficient. This implies that individuals' time-invariant unobserved characteristics (such as ability), otherwise likely to represent a potential source of bias, are uncorrelated with the error term or duly accounted for in the model.

Since a FE estimator removes the individual mean for each regressor, it does not provide an estimate for the impact of time-invariant variables, namely *voc* and its interactions with experience. As a result, the choice of the estimation method falls on the RE one²³.

Estimates of model (2) by RE are presented in column (B) of table 2²⁴. The coefficient of *voc* indicates that workers who pursued vocational education in upper secondary earn about 2.8% more than those with general education when entering the labor market, on average and all else constant. However, and as suggested by the pooled OLS estimates, the slope is less steep for the group of vocationally educated workers (given the negative coefficient of *voc * exp*) and the concavity is less pronounced or inexistent (given the positive coefficient of *voc * exp*²).

²¹ See table A.5 in the appendix.

²² See table A.6 in the appendix.

²³ An alternative method to estimate the returns to education is the Hausman-Taylor estimator, as proposed by Hausman and Taylor (1981). However, since in my study the Hausman Test does not reject the exogeneity condition between the error term and the individual-specific effects, the premise to rely on the Hausman-Taylor estimator fails to hold. Therefore, the Hausman-Taylor estimation will not be performed in this paper.

²⁴ This model assumes a compounded error term, composed by the individual-specific effects μ_i and the idiosyncratic error ε_{it} . The ρ estimate confirms the presence of individual-specific effects which account for 68% of the variance of the composite error.

Table 2. Estimates of empirical models.

	(A) OLS	(B) RE	(C) RE	(D) RE	(E) RE	(F) RE	(G) RE	(H) RE
Exp	0.0590 (0.0007)***	0.0417 (0.0006)***	0.0345 (0.0006)***	0.0416 (0.0006)***	0.0356 (0.0006)***	0.0378 (0.0006)***	0.0211 (0.0006)***	0.0204 (0.0005)***
Exp²	-0.0015 (0.0001)***	-0.0006 (0.0001)***	-0.0005 (0.0001)***	-0.0006 (0.0001)***	-0.0006 (0.0001)***	-0.0005 (0.0001)***	-0.0001 (0.0001)**	-0.0001 (0.0001)
Voc	0.0269 (0.0024)***	0.0275 (0.0024)***	0.0200 (0.0023)***	0.0351 (0.0024)***	0.0499 (0.0025)***	0.0281 (0.0024)***	0.0190 (0.0018)***	0.0206 (0.0017)***
Voc*Exp	-0.0055 (0.0016)***	-0.0101 (0.0011)***	-0.0093 (0.0011)***	-0.0094 (0.0011)***	-0.0123 (0.0012)***	-0.0100 (0.0011)***	-0.0025 (0.0010)**	-0.0020 (0.0010)**
Voc*Exp²	-0.0004 (0.0002)*	0.0005 (0.0001)***	0.0005 (0.0001)***	0.0005 (0.0001)***	0.0010 (0.0002)***	0.0005 (0.0001)***	-0.0001 (0.0001)	-0.0000 (.0001218)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dummies for industry and hierarchy levels	No	No	Yes	No	No	No	Yes	Yes
Dummies for region	No	No	No	Yes	No	No	Yes	Yes
Firm ownership, sales, no. of branches and no. of employees	No	No	No	No	Yes	No	Yes	Yes
Dummies for being present with 18, 19, 20 and 21 years old	No	No	No	No	No	Yes	Yes	Yes
Hours worked per week	No	No	No	No	No	No	Yes	No
Restrained sample: only full-time workers	No	No	No	No	No	No	No	Yes
No. of observations	1794272	1794272	1698421	1794268	1593960	1794272	1509643	1311592
No. of individuals	-	633549	602531	633548	582554	633549	553319	475860
R-squared (overall)	0.1964	0.1949	0.2750	0.2104	0.2668	0.1948	0.5403	0.4460
ρ	-	0.6759	0.6506	0.6729	0.6616	0.6758	0.5578	0.5677

Source: *Quadros de Pessoal*

Note: Dependent variable: logarithm of wage. All models were estimated with a constant and controls for gender, age, age², tenure, tenure², a dummy for having labor market experience before completing upper secondary education and the interaction between that dummy and the variable *voc*. Robust standard errors in parentheses. Significant at ***1%, **5%, *10%.

Hence, results of specification (2) corroborate the existence of an initial wage premium that dissipates over time for workers with vocational studies. Nevertheless, other relevant variables may be included in the model, such as jobs' and firms' characteristics, in order to check the sensitivity of the coefficients and the robustness of the conclusions. The estimates resulting from the inclusion of additional variables are presented in columns (C) through (F). However, since the access to a given job category or the achievement of a particular hierarchical level may themselves be benefits intrinsic to an education type, the inclusion of such controls narrows the analysis given the conditional nature of the marginal effect.

Column (C) shows the result of including dummy variables for the industry in which the firm operates and the hierarchy level of the worker within the firm. The inclusion of such controls reduces the initial wage advantage of vocational education (the coefficient of *voc* becomes 0.02).

In column (D) the model is added binary variables for the region where the firm is located, while in column (E) I included the logarithm of firms' sales, the number of branches, the number of employees and the share of firms' capital stock that is public, private and national and foreign. Both models result in an augmented coefficient of *voc* (0.0351 and 0.0499, respectively).

While in most empirical studies the return to education falls when job and firm controls are included²⁵, in this work that is the case when controlling for industry and hierarchy levels but the reverse happens when firms' region, ownership and size are accounted for.

In column (F) I added four binary variables, each one equal to 1 if the worker was observed in *Quadros de Pessoal* with 18, 19, 20 and 21 years old, respectively. The aim was to control for differentiated levels of ability and capture a potential signaling effect. For instance, working with 18 years old may give a negative signal to the employer that the worker started working too young. On the other hand, it may signal a proactive individual. In turn, working with 19 years old

²⁵ Pereira and Martins (2002) performed a meta-analysis using several Portuguese studies on the returns to education and found that "job-related controls in Mincer equations substantially decreased returns".

may well be seen as a positive signal that the individual completed upper secondary in due time.

The inclusion of these variables barely alters the coefficient of *voc*.

Finally, I estimated a model including all variables reported from columns (C) to (F), as well as the hours worked per week, that is:

$$\begin{aligned}
 lwage_{it} = & \beta_0 + \beta_1 female_i + \beta_2 age_{it} + \beta_3 age_{it}^2 + \beta_4 exp_{it} + \beta_5 exp_{it}^2 + \beta_6 voc_i + \\
 & \beta_7 voc_i * exp_{it} + \beta_8 voc_i * exp_{it}^2 + \beta_9 previousexp_i + \beta_{10} voc_i * previousexp_i + \\
 & \beta_{11} tenure_{it} + \beta_{12} tenure_{it}^2 + \beta_{13} T_t + \beta_{14} I_{it} + \beta_{15} H_{it} + \beta_{16} R_{it} + \beta_{17} F_{it} + \beta_{18} P_{it} + \\
 & \beta_{19} hours_{it} + \mu_i + \varepsilon_{it}
 \end{aligned} \tag{3}$$

In model (3), *I* is a vector of the industries considered, *H* is a vector of the hierarchy levels, *R* is a vector of the regions, *F* stands for a vector of the firms' characteristics introduced in column (E), *P* is a vector of the four binary variables controlling for presence with 18, 19, 20 and 21 years old and *hours* denotes hours worked per week. Considering model (2) the restricted model and model (3) the unrestricted one, I computed an F-test which proved that the additional controls are jointly relevant²⁶.

Estimates of such complete specification are shown in column (G) of table 2²⁷. Results are that wages of workers with vocational education are about 2% higher than those with general education at the beginning of the career, on average, *ceteris paribus*. Even though this represents a fall of about 0.8 percentage points relative to the same coefficient in the parsimonious regression (model (2)), it still supports the thesis that job-oriented tracks provide their students differentiated skills that are rewarded by the employer when entering the labor market. The knowledge and competencies acquired in school in such courses may indeed produce a better match between the employer and the employee, who already knows how to perform the job or requires less training (and thus lower training costs) to learn it, vis-à-vis his counterparts. Furthermore, once again, results point to a larger wage growth for generally educated workers (the coefficient of *voc * exp*

²⁶ See table A.7 in appendix. The null hypothesis that all coefficients are equal to zero is rejected at all significance levels.

²⁷ See table A.8 in appendix for a complete report of the estimates of model (3).

is negative) who catch up the vocationally educated ones later in time. The coefficient of $voc * exp^2$ is now insignificant suggesting that the wage-experience patterns of the two groups of workers have the same curvature.

To compute the earnings profiles I run the same model (model (3)) without the independent variables that yielded insignificant coefficients²⁸ and evaluated the regression at average values of all variables but voc , exp , exp^2 and interaction $voc * exp$. I let exp to vary within its whole range (between 0 and 16) and calculated the fitted regression for the group of workers with general and vocational education. The wage-experience patterns obtained are as follows²⁹:

$$\text{General education: } lwage = 6.5585 + 0.0211exp - 0.0001exp^2 \quad (4)$$

$$\text{Vocational education: } lwage = 6.5781 + 0.0186exp - 0.0001exp^2 \quad (5)$$

The difference in the intercept of the two curves is therefore given by the (re-estimated) coefficient of voc (0.0196) while the difference in slopes is given by that of $voc * exp$ (-0.0026).

The graphical representation of both curves is displayed in figure 3. As it is evident in the figure, the marginal effect of pursuing a job-oriented stream in upper secondary decreases with labor market experience³⁰. Particularly, as mentioned before, when entering the labor market workers with vocational studies earn about 2% more than the counterfactual group; after five years of experience they earn 0.68% more, after ten years they face a wage disadvantage of 0.61% and with fifteen years of experience they earn about 2% less. The catch up moment occurs at 7.84 years of experience (approximately seven years and ten months), when the two curves cross each other. From then onwards, the marginal effect becomes negative.

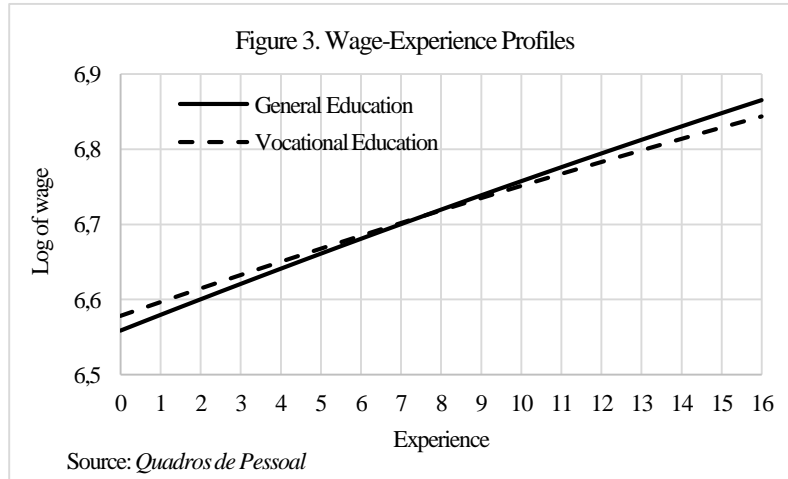
²⁸ The independent variables that yielded insignificant coefficients in model (3) were $voc * exp^2$, $voc * previousexp$ and the binary variable for extractive industry.

²⁹ The expression that originated equations (4) and (5) is given by:

$$\begin{aligned} lwage &= \widehat{\beta}_0 + \widehat{\beta}'\bar{X} + \widehat{\beta}_{voc}voc + \widehat{\beta}_{exp}exp + \widehat{\beta}_{voc*exp}(voc * exp) + \widehat{\beta}_{exp^2}exp^2 \\ \Leftrightarrow lwage &= 6.5585 + 0.0196voc + 0.0211exp - 0.0026(voc * exp) - 0.0001exp^2 \end{aligned}$$

The intercept term was obtained by summing the constant estimated in the model and the product of the coefficients and average values of the independent variables displayed in table A.9 in the appendix.

³⁰ The marginal effect is given by the derivative of the regression in order to voc . That is: $\frac{dlwage}{dvoc} = 0.0196 - 0.0026exp$. Equivalently, the marginal effect equals the difference between the two curves.



On the arguments for such differentiated patterns, Hanushek, Woessman and Zhang (2011) state that vocational education helps “improving the transition from schooling to work, but it also appears to have an impact on the adaptability of workers to technological and structural change in the economy”. Moreover, the authors found that “with increasing age, individuals with general education are more likely to take any career-related training” which boosts productivity beyond that of workers with vocational education.

Cörvers et al. (2011) point out that the differences in curriculum are responsible for a more or less flexible labor force: “general education delivers a body of general knowledge that is the foundation for efficient job adjustments over their [workers with general education] careers and for responding rapidly to technological change”.

In Portugal, the ever ongoing debate on the less demanding content of job-oriented tracks, largely seen as alternative paths for students with unsuccessful academic backgrounds, supports the argument that general education prepare its students better in terms of analytical and critical thinking. Such competencies, along with ability itself, may generate a stronger potential for engaging in productivity-enhancing activities, as well as higher adaptability to different jobs and a

higher probability of hierarchical mobility³¹; all of which may result in higher earnings and overcome the initial lower match of these individuals.

Regarding other coefficients of interest³², estimates of model (3) highlight the gender disparity in earnings. The coefficient of *female* reveals that women earn about 12% less than men. The coefficient of *previousexp* (-0.0484) points to a negative impact of having working experience before reporting upper secondary attainment, which may be correlated with the decision of accumulating studies with a job or of returning later to school to finish upper secondary education. Nevertheless, such negative impact is the same across the two groups of workers (the coefficient of *voc * previousexp* is insignificant). Regarding the four binary variables for being observed in *Quadros de Pessoal* with 18, 19, 20 and 21 years old, only the first generates a negative effect on wages (-0.0142), which may indicate an early entrance in the labor market to be a negative signal for the employer.

Finally, I estimated model (3) for full-time workers only. The estimates are displayed in column (H) of table 2 and are very similar to those in column (G), which confirms the robustness of the previous results.

5.1. Investigating differences between job-oriented tracks

In order to investigate potential differences between job-oriented tracks I used data on the type of vocational education pursued in upper secondary. I therefore distinguished between workers who completed *vocational courses of level III* and other type of job-oriented tracks. In the sample, 14.64% of the vocationally educated workers pursued a *vocational course of level III* while the remaining completed other job-oriented stream.

³¹ Recall that figures in table 1 suggest higher hierarchical mobility among the group of generally educated workers.

³² See table A.8 in the appendix.

At this stage, I repeated the methodology followed before. First, I estimated model (3) replacing the variable *voc* by two dummy variables for having attended a *vocational course of level III* (*vocIII*) or other job-oriented track (*othertrack*). Afterwards, I reestimated that model without the variables that provided insignificant coefficients and then evaluated the regression at average values of all variables but *exp*, *exp*², *vocIII*, *othertrack* and the respective interactions. The resultant wage-experience patterns, graphically represented in figure 4, are³³:

$$\text{General education: } lwage = 6.6404 + 0.021exp - 0.0001exp^2 \quad (6)$$

$$\text{Vocational courses of level III: } lwage = 6.7 + 0.021exp - 0.0008exp^2 \quad (7)$$

$$\text{Other job-oriented tracks: } lwage = 6.6534 + 0.0187exp - 0.0001exp^2 \quad (8)$$

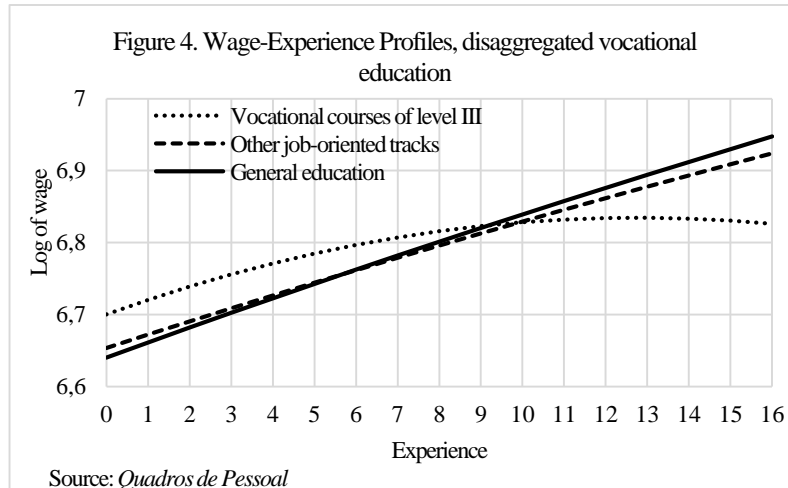
Results are that the initial wage advantage of vocational education is larger for *vocational courses of level III* than for other job-oriented tracks. The coefficients on *vocIII* and *othertrack* indicate a marginal impact of about 6% and 1.3%, respectively, relative to the academic stream when the worker has no experience (on average and all else constant)³⁴. Moreover, workers with general education catch up workers with *vocational courses of level III* around ten years of experience, while they catch up workers from other job-oriented streams at five years and eight months of experience. Furthermore, given the more pronounced concavity of the wage-experience pattern of workers who pursued a *vocational course of level III*, the earnings of these workers will diverge further from the earnings of the comparison group later in life.

³³ The expression that originated equations (6), (7) and (8) is given by:

$$\begin{aligned} lwage &= \widehat{\beta}_0 + \widehat{\beta}'\bar{X} + \widehat{\beta}_{vocIII}vocIII + \widehat{\beta}_{othertrack}othertrack + \widehat{\beta}_{exp}exp \\ &\quad + \widehat{\beta}_{othertrack*exp}(othertrack * exp) + \widehat{\beta}_{exp^2}exp^2 + \widehat{\beta}_{vocIII*exp^2}vocIII * exp^2 \\ \Leftrightarrow lwage &= 6.6404 + 0.0598vocIII + 0.013othertrack + 0.021exp - 0.0023(othertrack * exp) \\ &\quad - 0.0001exp^2 - 0.0007(vocIII * exp^2) \end{aligned}$$

The intercept term was obtained by summing the constant estimated in the model and the product of the coefficients and average values of the independent variables displayed in table A.10 in the appendix.

³⁴ The marginal effects are given by $\frac{dlwage}{dvocIII} = 0.0598 - 0.0007exp^2$ and $\frac{dlwage}{dothertrack} = 0.013 - 0.0023exp$. Equivalently, the marginal effects equal the difference between the curve for *vocational courses of level III* and general education, and the difference between the curve for other job-oriented tracks and general education, respectively.



6. Conclusion

For the purpose of assessing the wage returns to different types of education, I focused my study on a period of great expansion of vocational studies, that is, after the creation of vocational schools in 1989. Using *Quadros de Pessoal*, I followed a panel of individuals with upper secondary attainment born between January 1974 and December 1990, between 1993 and 2009.

Given the concerns with self-selection and ability bias common in this literature, I applied the Hausman Test which indicated that individuals' unobserved characteristics are uncorrelated with the error term or duly accounted for in the model. Therefore, I employed a RE model.

Estimates revealed a wage advantage for workers with vocational education vis-à-vis workers with general education, in the beginning of the career. Particularly, accounting for both workers' and firms' characteristics, the former group earns on average around 2% more than the latter. However, the earnings of vocationally educated workers grow at a slower rate and are surpassed by the earnings of generally educated workers at around eight years of experience. Such wage-experience profile is more pronounced in the case of *vocational courses of level III* when compared to other job-oriented tracks.

In a nutshell, I found empirical evidence of a positive answer to both research questions.

The main policy implication derived from these results is the need to offer students of job-oriented tracks a general component that is relevant, properly demanding and aligned with the vocational part. While job-related skills are especially important to assure a smooth transition from school to the labor market, fostering general skills seems to be particularly relevant in the future.

This study represents a valuable contribution to the barely existent literature on the topic of returns to different types of education in Portugal. Specially, in the present context of a growing importance of firms and labor market institutions for the design of education policy.

Nevertheless, its main limitation lies on one characteristic of the dataset. The survey's question with respect to the type of education is not totally clear regarding the option considered as "general education"; it reads "12th grade of the academic track or equivalent with professional content". Consequently, some workers with vocational education may have indicated this answer.

In the future, it would be relevant to use other datasets in order to check the robustness of the results and also include socioeconomic controls (absent in *Quadros de Pessoal*) if available. Further research on outcomes other than the wage is also pertinent, namely the probability of achieving a certain job, hierarchic level or working in a certain industry. Moreover, the inclusion of self-employed and unemployed individuals would be of importance as well as the derivation of employment-experience patterns (which requires a dataset other than *Quadros de Pessoal*). Ultimately, this would enable the researcher to balance the lifecycle behavior of wages and employment so as to compute the lifetime income of the two groups of workers³⁵. Furthermore, it would be interesting to study the relation between the field of study and the working field (which requires a dataset other than *Quadros de Pessoal*), and the differences in tenure and job turnover between the two groups (closely related to the job-matching theory). Finally, integrating data about on-the-job training in this study would be an additional contribution.

³⁵ As studied, for instance, by Hanushek, Woessman and Zhang (2011) and Koerselman and Uusitalo (2013).

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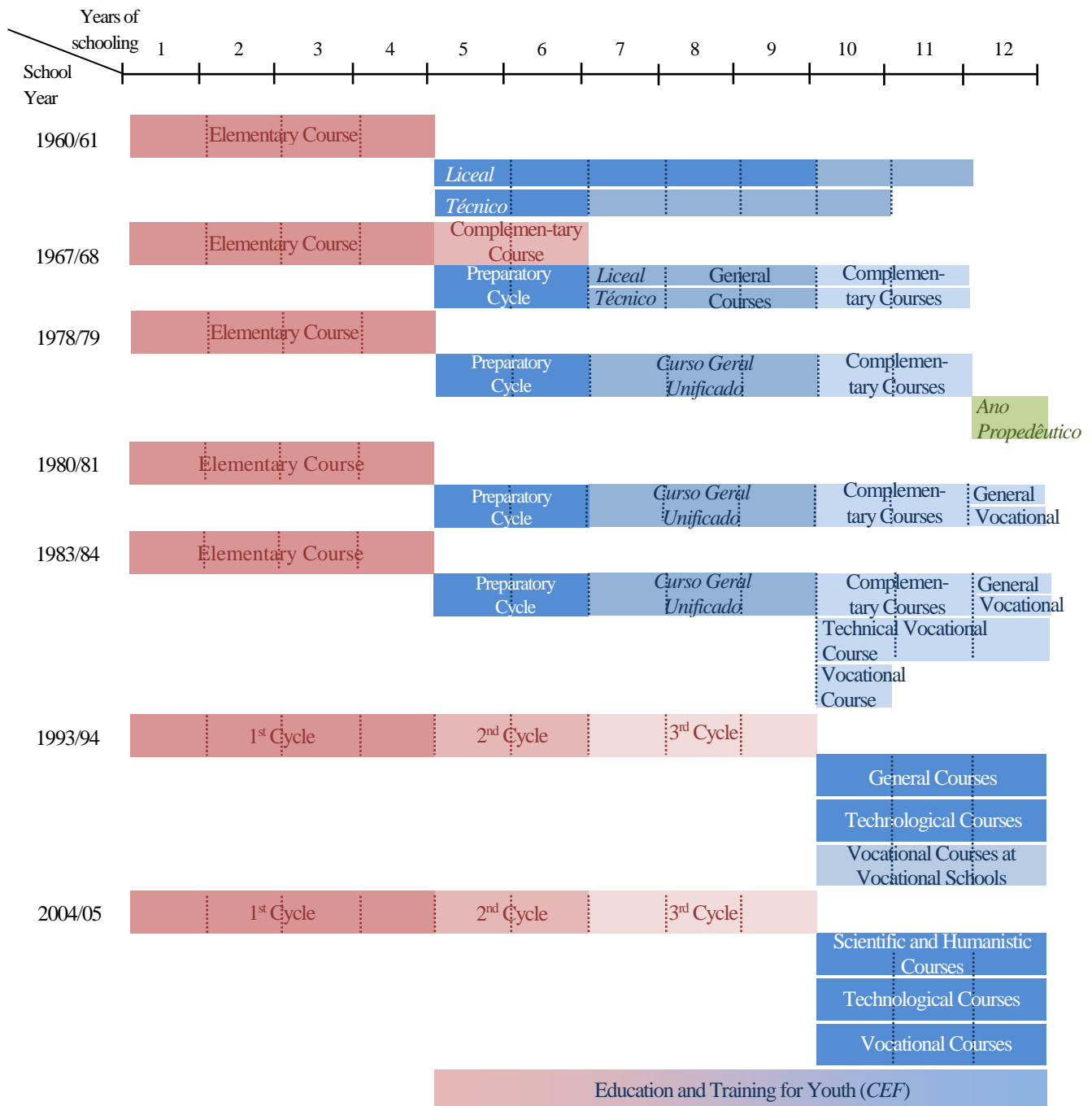
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Appendix

Figure A.1. The evolution of the Portuguese education system, from 1960 to 2004.



Source: Author's construction.

Note: Red tones correspond to Primary Education (until 1985/86) and basic education (after 1986/87). Blue tones correspond to secondary education as in the Portuguese terminology. In international terms until 6th grade is primary education, from 7th to 9th grade is the lower secondary level and from 10th to 12th grade is the upper secondary level. Green tones correspond to higher education.

Table A.1. English-Portuguese translation of terms used in this report (by order of appearance).

English	Portuguese
Vocational education or Job-oriented tracks	Ensino profissional
General education or Academic track	Ensino regular
Technical vocational course	Curso técnico-profissional
Vocational course	Curso profissional
General courses	Cursos gerais
Scientific and humanistic courses	Cursos científico-humanísticos
Technological courses	Cursos tecnológicos
Vocational schools	Escolas profissionais
Vocational courses of level III	Cursos profissionais de nível III
Education and training courses for youth	Cursos de Educação e Formação (CEF)
Apprenticeship courses	Cursos de Aprendizagem
Education and training for adults	Educação e Formação de Adultos (EFA)

Source: Author's construction.

Table A.2. *Quadro Nacional de Qualificações.*

Qualification Level from QNQ	Qualification	Courses that award that Qualification
1*	2 nd cycle of Basic Education	General Education
	2 nd cycle of Basic Education and professional qualification of level I	Education and Training for Youth (CEF) Education and Training for Adults (EFA) Recurrent Education
	3 rd cycle of Basic Education	General Education
2*	3 rd cycle of Basic Education and professional qualification of level II	Education and Training for Youth (CEF) Education and Training for Adults (EFA) Recurrent Education
	Upper Secondary Education	General Education (Scientific and Humanistic Courses)
	Upper Secondary Education and professional qualification of level III	Technological Courses Vocational Courses Education and Training for Youth (CEF) Education and Training for Adults (EFA) Recurrent Education Apprenticeship Courses
5*	Post-secondary Non-tertiary Education and professional qualification of level IV	<i>CET – Curso de Especialização Tecnológica</i>
6*	1 st cycle of Tertiary Education	<i>Licenciatura</i>
7*	2 nd cycle of Tertiary Education	<i>Mestrado</i>
8*	3 rd cycle of Tertiary Education	<i>Doutoramento</i>

* Not covered in this report.

Source: Despacho n.º 978/2011 (published in *Diário da República*, 2.ª série, N.º 8, 12 de Janeiro de 2011), and author's construction.

Table A.3. Main Portuguese Legislation concerning the evolution of the education system, between 1960 and 2004.

Piece of Legislation	Measures/Reforms
Decree-Law no. 42/994, from May 28 th 1960	Mandatory schooling was raised to 4 years
Decree-Law no. 45/810, from July 9 th 1964	Mandatory schooling was raised to 6 years
Decree-Law no. 47/430, from January 2 nd 1967	Unification of the preparatory cycle of Secondary Education
Law no. 5/73, from July 25 th 1973	Veiga Simão's Reform
Decree-Law no. 260-B/75, from May 26 th 1975	Gradual implementation of the <i>curso geral unificado</i> (7 th , 8 th and 9 th grades). All schools providing Secondary Education were named High-Schools.
Decree-Law no. 491/77, from November 23 rd 1977	Creation of <i>ano propedêutico</i>
<i>Despacho Normativo</i> no. 140-A/78, from June 22 nd 1978	Unification of the complementary courses of Secondary Education (10 th and 11 th grades)
Decree-Law no. 240/80, from July 19 th 1980	Creation of the 12 th grade
<i>Despacho Normativo</i> no. 194-A/83, from October 21 st 1983	Seabra's Reform
Decree-Law no. 102/84, from March 29 th 1984	Creation of <i> cursos de aprendizagem</i> (dual system)
Law no. 46/86, from October 14 th 1986	<i>Lei de Bases do Ensino Educativo</i> ; Mandatory schooling was raised to nine years
Decree-Law no. 26/89, from January 21 st 1989	Creation of the Vocational Schools
Decree-Law no. 286/89, from August 29 th 1989	Curricular reform for both Basic and Secondary Education, following the new structure bent in 1986
<i>Despacho Conjunto</i> no. 123/97, from June 16 th 1997, Ministry of Education and Ministry of Employment and Solidarity	Creation of Education and Training Courses for Youth and Adults (CEF and EFA, respectively)
<i>Portaria</i> no. 550-C/2004, from May 21 st 2004	Vocational courses were integrated in public high-schools

Source: *Diário da República Eletrónico*

Table A.4. Test for the inclusion of time fixed-effects.

testparm t1994 t1995 t1996 t1997 t1998 t1999 t2000 t2002 t2003 t2004 t2005 t2006 t2007 t2008 t2009
(1) t2009 = 0
(2) t2008 = 0
(3) t2007 = 0
(4) t2006 = 0
(5) t2005 = 0
(6) t2004 = 0
(7) t2003 = 0
(8) t2002 = 0
(9) t2000 = 0
(10) t1999 = 0
(11) t1998 = 0
(12) t1997 = 0
(13) t1996 = 0
(14) t1995 = 0
(15) t1994 = 0
chi2(15) = 11595.21
Prob>chi2 = 0.0000

Table A.5. Breusch and Pagan Lagrangian multiplier test for random effects.

xttest0

lwage[i,t] = Xb + u[i] + e[i,t]

Estimated results:

	Var	sd=sqrt(Var)
lwage	0.3102943	0.5570407
e	0.0947607	0.3078322
u	0.1976173	0.4445417

Test: Var(u)=0

chibar2(01) = 8.3e+05
Prob>chibar2 = 0.0000

hausman FE RE

Table A.7. Test for the inclusion of the controls added in model (3).

(1) hours = 0	(12) primary = 0	(23) lisboa = 0
(2) present18 = 0	(13) extractive = 0	(24) alentejo = 0
(3) present19 = 0	(14) manufacturing = 0	(25) açores = 0
(4) present20 = 0	(15) utilities = 0	(26) madeira = 0
(5) present21 = 0	(16) construction = 0	(27) lsales = 0
(6) senior = 0	(17) commerceresthot = 0	(28) cprivate = 0
(7) middle = 0	(18) transpcommunic = 0	(29) cpublic = 0
(8) crewchief = 0	(19) financonsultrestate = 0	(30) cforeign = 0
(9) hqualprof = 0	(20) norte = 0	(31) nbranches = 0
(10) qualprof = 0	(21) algarve = 0	(32) nemployees = 0
(11) semiqualfprof = 0	(22) centro = 0	

chi2(32) = 4.8e+05
 Prob > chi2 = 0.0000

Table A.8. All estimates from model (3).

Variable	Coefficient	(continuation)	Coefficient	(continuation)	Coefficient	(continuation)	Coefficient
Constant	4.0334 (0.0210)***	Present19	0.0066 (0.0015)***	Transports and communication	0.0855 (0.0028)***	t2009	0.0768 (0.0080)***
Female	-0.1191 (0.0010)***	Present20	0.0051 (0.0013)***	Finan. Inst., consult., real estate	0.0309 (0.0021)***	t2008	0.0897 (0.0079)***
Age	0.0428 (0.0014)***	Present21	0.0039 (0.0011)***	Norte	-0.4480 (0.0039)***	t2007	0.0990 (0.0079)***
Age ²	-0.0005 (0.0000)***	Senior management	0.3568 (0.0046)***	Algarve	-0.3372 (0.0046)***	t2006	0.1159 (0.0080)***
Exp	0.0211 (0.0006)***	Middle management	0.3115 (0.0031)***	Centro	-0.4540 (0.0040)***	t2005	0.1359 (0.0080)***
Exp ²	-0.0001 (0.0001)**	Crew chiefs	0.2894 (0.0030)***	Lisboa	-0.3819 (0.0038)***	t2004	0.1356 (0.0080)***
Voc	0.0190 (0.0018)***	Highly qualified professionals	0.2323 (0.0018)***	Alentejo	-0.4032 (0.0044)***	t2003	0.1361 (0.0080)***
Voc*Exp	-0.0025 (0.0010)**	Qualified professionals	0.1010 (0.0009)***	Açores	-0.4545 (0.0051)***	t2002	0.1643 (0.0080)***
Voc*Exp ²	-0.0000 (0.0001)	Semi-qual. professionals	0.0487 (0.0011)***	Madeira	-0.3748 (0.0048)***	t2000	0.1559 (0.0080)***
Previousexp	-0.0484 (0.0011)***	Primary sector	-0.0483 (0.0060)***	Log of sales	0.0462 (0.0002)***	t1999	0.1486 (0.0080)***
Voc* Previousexp	0.0020 (0.0031)	Extractive Industry	0.0103 (0.0110)	% capital private	0.0004 (0.0000)***	t1998	0.1203 (0.0081)***
Tenure	0.0127 (0.0004)***	Manufacturing	-0.0588 (0.0022)***	% capital public	0.0016 (0.0000)***	t1997	0.0612 (0.0081)***
Tenure ²	-0.0010 (0.0000)***	Utilities	0.0210 (0.0072)***	% capital foreign	0.0011 (0.0000)***	t1996	0.0411 (0.0083)***
Hours worked per week	0.0323 (0.0001)***	Construction	-0.0552 (0.0026)***	No. of branches	0.0001 (0.0000)***	t1995	0.0372 (0.0086)***
Present18	-0.0142 (0.0021)***	Commerce, restaurants, hotels	-0.0966 (0.0020)***	No. of employees	-0.0000 (0.0000)***	t1994	0.0410 (0.0096)***

Source: *Quadros de Pessoal*

Note: Dependent variable: logarithm of wage. Robust standard errors in parentheses. Significant at ***1%, **5%, *10%.

Table A.9. Coefficients and summary of variables used to compute equations (4) and (5).

Variable	Coefficient	Mean	St. Dev	Min	Max
Constant	4.0335***				
Female	-0.1191***	0.5271	0.4993	0	1
Age	0.0428***	25.6265	4.0336	17	35
Age ²	-0.0005***	672.9875	210.8154	289	1225
Exp	0.0211***	-	-	0	16
Exp ²	-0.0001**	-	-	0	256
Voc	0.0196***	-	-	0	1
Voc*Exp	-0.0026***	-	-	0	16
Previousexp	-0.0481***	0.2731	0.4456	0	1
Tenure	0.0127***	2.5101	2.8920	0	27
Tenure ²	-0.0010***	14.6641	29.0616	0	729
Hours worked per week	0.0323***	39.2437	8.0565	0	56.25
Present18	-0.0142***	0.0521	0.2222	0	1
Present19	0.0066***	0.1335	0.3401	0	1
Present20	0.0051***	0.2377	0.4257	0	1
Present21	0.0039***	0.3349	0.4719	0	1
Senior management	0.3568***	0.0132	0.1141	0	1
Middle management	0.3115***	0.0258	0.1586	0	1
Crew chiefs	0.2894***	0.0220	0.1468	0	1
Highly qualified prof.	0.2323***	0.0849	0.2788	0	1
Qualified professionals	0.1100***	0.4453	0.4970	0	1
Semi-qual. professionals	0.0487***	0.1797	0.3839	0	1
Primary sector	-0.0485***	0.0059	0.0766	0	1
Manufacturing	-0.0590***	0.1706	0.3761	0	1
Utilities	0.0298***	0.0044	0.0659	0	1
Construction	-0.0555***	0.0569	0.2317	0	1
Commerce, rest., hotels	-0.0968***	0.3836	0.4863	0	1
Transp. and communic.	0.0853***	0.0690	0.2534	0	1
FI, consultancy, real estate	0.0307***	0.1949	0.3961	0	1

(continuation)

Variable	Coefficient	Mean	St. Dev	Min	Max
Norte	-0.4480***	0.2746	0.4463	0	1
Algarve	-0.3372***	0.0324	0.1771	0	1
Centro	-0.4540***	0.1527	0.3597	0	1
Lisboa	-0.3819***	0.4520	0.4977	0	1
Alentejo	-0.4031***	0.0453	0.2081	0	1
Açores	-0.4545***	0.0183	0.1342	0	1
Madeira	-0.3748***	0.0246	0.1549	0	1
Log of sales	0.0462***	15.3672	2.8489	6	21
% capital private	0.0004***	70.0658	44.9394	0	100
% capital public	0.0016***	4.0648	19.2784	0	100
% capital foreign	0.0011***	14.5408	34.2013	0	100
No. of branches	0.0001***	33.0660	125.3064	1	1057
No. of employees	0.0000***	1260.087	3177.779	1	19967
t2009	0.0767***	0.1484	0.3555	0	1
t2008	0.0897***	0.1447	0.3518	0	1
t2007	0.0990***	0.1293	0.3356	0	1
t2006	0.1159***	0.1138	0.3175	0	1
t2005	0.1358***	0.1012	0.3015	0	1
t2004	0.1356***	0.0814	0.2735	0	1
t2003	0.1361***	0.0703	0.2557	0	1
t2002	0.1642***	0.0598	0.2371	0	1
t2000	0.1559***	0.0440	0.2050	0	1
t1999	0.1486***	0.0352	0.1843	0	1
t1998	0.1203***	0.0278	0.1645	0	1
t1997	0.0612***	0.0200	0.1400	0	1
t1996	0.0410***	0.0117	0.1074	0	1
t1995	0.0372***	0.0069	0.0827	0	1
t1994	0.0410***	0.0035	0.0588	0	1

Source: *Quadros de Pessoal*

Note: Dependent variable: logarithm of wage. Significant at ***1%, **5%, *10%.

Table A.10. Coefficients and summary of variables used to compute equations (6), (7) and (8).

Variable	Coefficient	Mean	St. Dev	Min	Max
Constant	4.0345***				
Female	-0.1191***	0.5271	0.4993	0	1
Age	0.0427***	25.6265	4.0336	17	35
Age ²	-0.0005***	672.9875	210.8154	289	1225
Exp	0.0210***	-	-	0	16
Exp ²	-0.0001**	-	-	0	256
VocIII	0.0598***	-	-	0	1
Othertrack	0.0130***	-	-	0	1
VocIII*Exp ²	-0.0007***	-	-	0	256
Othertrack*Exp	-0.0023***	-	-	0	16
Previousexp	-0.0479***	0.2731	0.4456	0	1
Tenure	0.0127***	2.5101	2.8920	0	27
Tenure ²	-0.0010***	14.6641	29.0616	0	729
Hours worked per week	0.0323***	39.2437	8.0565	0	56.25
Present18	-0.0140***	0.0521	0.2222	0	1
Present19	0.0067***	0.1335	0.3401	0	1
Present20	0.0051***	0.2377	0.4257	0	1
Present21	0.0039***	0.3349	0.4719	0	1
Senior management	0.3564***	0.0132	0.1141	0	1
Middle management	0.3110***	0.0258	0.1586	0	1
Crew chiefs	0.2893***	0.0220	0.1468	0	1
Highly qualified prof.	0.2320***	0.0849	0.2788	0	1
Qualified professionals	0.1099***	0.4453	0.4970	0	1
Semi-qual. professionals	0.0487***	0.1797	0.3839	0	1
Primary sector	-0.0482***	0.0059	0.0766	0	1
Manufacturing	-0.0588***	0.1706	0.3761	0	1
Utilities	0.2982***	0.0044	0.0659	0	1
Construction	-0.0553***	0.0569	0.2317	0	1
Commerce, rest., hotels	-0.0965***	0.3836	0.4863	0	1
Transp. and communic.	0.0855***	0.0690	0.2534	0	1
FI, consultancy, real estate	0.0309***	0.1949	0.3961	0	1

(continuation)

Variable	Coefficient	Mean	St. Dev	Min	Max
Norte	-0.4482***	0.2746	0.4463	0	1
Algarve	-0.3372***	0.0324	0.1771	0	1
Centro	-0.4543***	0.1527	0.3597	0	1
Lisboa	-0.3820***	0.4520	0.4977	0	1
Alentejo	-0.4035***	0.0453	0.2081	0	1
Açores	-0.4558***	0.0183	0.1342	0	1
Madeira	-0.3751***	0.0246	0.1549	0	1
Log of sales	0.0462***	15.3672	2.8489	6	21
% capital private	0.0004***	70.0658	44.9394	0	100
% capital public	0.0016***	4.0648	19.2784	0	100
% capital foreign	0.0011***	14.5408	34.2013	0	100
No. of branches	0.0009***	33.0660	125.3064	1	1057
No. of employees	-0.0000***	1260.087	3177.779	1	19967
t2009	0.0759***	0.1484	0.3555	0	1
t2008	0.0889***	0.1447	0.3518	0	1
t2007	0.9819***	0.1293	0.3356	0	1
t2006	0.1151***	0.1138	0.3175	0	1
t2005	0.1350***	0.1012	0.3015	0	1
t2004	0.1348***	0.0814	0.2735	0	1
t2003	0.1353***	0.0703	0.2557	0	1
t2002	0.1635***	0.0598	0.2371	0	1
t2000	0.1552***	0.0440	0.2050	0	1
t1999	0.1478***	0.0352	0.1843	0	1
t1998	0.1195***	0.0278	0.1645	0	1
t1997	0.0604***	0.0200	0.1400	0	1
t1996	0.0403***	0.0117	0.1074	0	1
t1995	0.0364***	0.0069	0.0827	0	1
t1994	0.0402***	0.0035	0.0588	0	1

Source: *Quadros de Pessoal*

Note: Dependent variable: logarithm of wage. Significant at ***1%, **5%, *10%.